

REMARKS

Claims 1-18 are currently pending in the application. By this amendment, claims 1, 7 and 14 are amended for the Examiner's consideration. Support for the amendment(s) is provided in at least at page 8 of the present specification. No new matter is added. Reconsideration of the rejected claims in view of the above amendments and the following remarks is respectfully requested.

Allowed Claims

Applicants appreciate the indication that claims 7-14 contain allowable subject matter. Applicants further appreciate the indication that claims 15 and 16 are allowed.

Applicants have amended claims 7 and 14 to independent form, including any intervening claims. Accordingly, claims 7 and 14 and those claims dependent on such claims are also in allowable condition. Applicants further submit that the remaining claims are in condition for allowance for the following reasons.

35 U.S.C. §102 Rejection

Claims 1, 2, 4, 17 and 18 were rejected under 35 U.S.C. §102(b) for being anticipated by U. S. Patent No. 5,823,429 to Beck et al. This rejection is respectfully traversed.

The invention is directed to, for example, a oil activated electronically, mechanically or hydraulically controlled fuel injector which is capable of providing a pilot injection of fuel into the combustion chamber of an engine. In embodiments, approximately, one cubic millimeter of fuel can be injected into the combustion chamber using the delay piston assembly. This small quantity of fuel (pilot injection) is injected into the engine prior to the main injection event, and will thus increase efficiency of the injection cycle and decrease engine noise and engine emissions, and eliminate the need for additional working fluid to be provided in order to provide a pilot quantity of fuel. In one embodiment, the small quantity of compressed fuel will force the delay piston assembly and more specifically a delay piston and the spring downwards. The delay

piston will then overlap with a groove so that a pilot quantity of fuel can be supplied to the nozzle for injection into the combustion chamber of the engine, via the injection nozzle. The delay piston is preferably positioned within a fist disk, closest to the high pressure chamber of the injector.

However, the Beck reference does not show these features with regard to the piston assembly, as submitted by the Examiner. As shown in Figure 2, for example, Beck shows a non-return valve assembly which includes a check valve 88 in fluid communication with the fuel discharge passage 86. As disclosed at col. 7, lines 3-12, the assembly

... prevents return flow from the nozzle cavity 82 to the high pressure chamber 52....

But, the piston valve assembly, i.e., check valve, is not used to provide a pilot quantity of fuel. Instead, the assembly

According to Beck, the check valve 88 was initially designed to stop fuel injection after closure. However, the original inventors of such check valve

... did not intend any fuel to be injected after check valve closure, and thus did not intend the disclosed HEUI assembly to operate as an accumulator-type injector assembly during any portion of an injection event.

See, col. 8, lines 1-8.

However, Beck discovered that injection may still take place after closure of the valve when a falling rate of the fuel pressure is at a certain level. Beck is using this additional fuel to produce a hybrid HEUI assembly under conditions where V_{ACC}/Q_{MAX} ¹ is between more than 1 and less

¹ According to Beck, the portion of the fuel discharge passage 86 loaded downstream of check valve 88 (including the cavity 84 and the annulus 83) and the annular nozzle cavity 82 have a combined volume designated V_{ACC} . Q_{MAX} is the quantity of fuel injected at full load, with smaller quantities being injected under light-load engine operating conditions.

than 10. By increasing the V_{ACC} , according to Beck, it is possible to use the falling rate of the fuel pressure to continue an injection event. This assembly is not used to begin an injection event, e.g., provide a pilot quantity of fuel. For example, as disclosed at col. 8, lines 53-60,

When the ratio V_{ACC} / Q_{MAX} is 10 or higher, nearly the entire fuel mass is injected following closure of the check valve 88. V_{ACC} can be increased in the assembly 10 by increasing the diameter of fuel discharge passage 86 during manufacture by adding additional passages in fluid communication with the passage 86; by sealing the spring chamber 92 and by placing in fluid communication with passage 86 (thereby making it part of passage 86) and simultaneously sealing the upper end of plunger 94 from the spring chamber; or by any other suitable measure.

That is, under the conditions of Beck, an injection is possible as the fuel rate falls (falling rate).

Thus, Beck does not contemplate the use of the check valve to provide a pilot injection of fuel. In fact, Beck is only using the assembly for “post-closure” event, not pre-injection events. Accordingly Applicants submit that the Beck reference and more particularly the assembly noted by the Examiner does not provide the same features as that of the claimed invention, both the structure and the method.

Applicants now request withdrawal of the rejection.

35 U.S.C. §103 Rejection

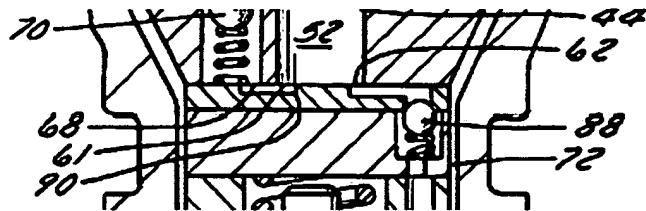
Claims 2, 3, 5 and 6 were rejected under 35 U.S.C. §103(a) for being unpatentable over Beck in view of U. S. Patent No. 5,544,816 to Nally et al. This rejection is respectfully traversed.

Applicants submit that claims 2, 3, 5 and 6 are dependent claims, depending from an allowable base claim. For this reason, Applicants submit that claims 2, 3, 5 and 6 are also allowable claims.

In addition, Applicants submit that these claims include allowable subject matter. For example, claim 3 recites that the delay piston assembly is positioned within at least the first disk. This disk is closest to the fuel pressure chamber. Also, claim 5 recites a groove positioned about

the delay piston assembly within the first disk. These features are not shown in the combination of references as presented by the Examiner.

Beck already shows two disks, as reproduced below.



However, the check valve is positioned within the second or lower disk. This disk is farthest away from the fuel pressure chamber 52. Also, neither of these disks show a groove positioned within the bores, making part of the passageway between the fuel pressure chamber 52 and the discharge port 86.

Now, the Examiner directs Applicants' attention to a "delay piston 24" of Nally. However, piston 24 is not a delay piston but is a needle valve 24, as discussed at col. 2, line 36. Thus, the feature in which the Examiner is relying upon for this §103(a) rejection does not appear to be present. For this reason, the Examiner does not appear to have provided a *prima facie* case of obviousness.

Additionally, the Examiner is of the opinion that it would have been obvious to position a "groove about a delay piston within the first disk in order to prevent the piston assembly from slipping from the disk." However, the groove of the invention is not provided for slippage. This groove provides a passage for a pilot quantity of fuel when the disk or valve assembly is pushed downwards by fuel pressure within the high pressure fuel chamber. Applicants submit that this is not an obvious, especially in view of the Examiner's admission that the groove is used for something which it is not.

Accordingly, Applicants respectfully request that the rejection over claims 2, 3, 5 and 6 be withdrawn.

CONCLUSION

Applicants appreciate the indication of allowable subject matter and allowed claims. However, in view of the foregoing amendments and remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicants hereby make a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 23-1951.

Respectfully submitted,



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